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ABSTRACT

The study examined the relationship between performance of 19 severely handicapped students under training conditions and under each of two types of probe conditions: (1) multiple opportunity (the student is given an opportunity to perform every step in a task analysis); and (2) single opportunity (the student is not given the opportunity to complete the task after the first error). Student data on performance of multiple-step functional tasks were collected and correlations were calculated between probe session scores and corresponding scores on training sessions closest in time. While the majority of student data sets were not significantly correlated, significant differences that did exist between groups indicated that single opportunity probe data were more likely to be variable, and the difference between probe and training scores was greater under the single opportunity probe condition. Results suggest that: (1) probe conditions are not the same as extinction; (2) training data do not consistently reflect performance under probe conditions; and (3) teachers may need to use different criteria to interpret data collected under different probe conditions. Includes 11 references. (Author/DB)

Assessing Student Performance: The Effect of Procedural Contrast Between Training and Probe Conditions[1, 2]

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Running head: PROCEDURAL CONTRAST

Abstract

Research on the procedural contrast between student performance under training conditions and under probe conditions has been equivocal. In some cases, subjects react to probe conditions as if they were extinction; in other cases, subjects' performance improved after repeated probe trials. This study examined the relationship between student performance under training conditions and under each of two types of probe conditions: a) multiple-opportunity (the student is given an opportunity to perform every step in a task analysis); and b) single-opportunity (the student is not given the opportunity to complete the task after the first error). Nineteen randomly selected sets of classroom data collected on performance of multiple-step functional tasks by students with severe handicaps were used in the analyses. Correlations were calculated between probe session scores and the corresponding scores on the training session conducted closest in time. T-tests were used to examine differences between the probe conditions.

While the majority of data sets were not significantly correlated, significant differences that did exist between groups indicated that single-opportunity probe data were more likely to be variable and the difference between probe and training scores was greater under the single-opportunity probe conditions. These

results suggest that: a) probe conditions are not the same as extinction; b) training data do not consistently reflect performance under probe conditions; and c) teachers may need to use different criteria to interpret data collected under different probe conditions.

Assessing Student Performance: The Effect of Procedural Contrast Between Training and Probe Conditions

Frequent and direct observational measures are recommended for assessing the progress of students with moderate to severe handicaps. While there is agreement that teachers should record either the steps of a skill students perform independently or the amount of assistance provided to complete a step, there are conflicting recommendations about the conditions for collecting data. Teachers may record data based on observation of student performance under training conditions (i.e., during instruction), when the student receives assistance and reinforcement, or based on observations of student performance during probe sessions when no reinforcement or assistance is available. The procedures and conditions used during data collection may impact student performance. The constrasting effects between various procedures (i.e., procedural contrast) on student performance has not been investigated thoroughly.

Assessment of student performance under probe, or test, conditions has been recommended because it reflects performance under "natural" conditions and criticized because it resembles extinction. Those in favor of probe data argue that probe data reflect more closely the conditions for skill performance in natural settings than do training data because behavior is observed

without artificial teacher cues or reinforcement. If students are expected to perform functional skills in the environment, they argue that the assessment of progress should reflect those conditions (Snell & Grigg, 1987). Probe data collected periodically during the instructional phase is also recommended for the assessment of student generalization, adaptation, and error patterns (Horner, Sprague, & Wilcox, 1982; Liberty, 1985; Wilcox & Bellamy, 1982).

By contrast, Cuvo (1979) has cautioned against the use of probe procedures. He argues that students who have experienced a rich schedule of reinforcement and assistance during instruction may not perform at their maximum level when confronted with probe conditions similar to extinction conditions. He suggests that probe conditions will be distressing to the students and performance may decrease.

Research comparing student performance under probe and training conditions is inconclusive. Some researchers (Buchwald, 1959a, 1959b, 1960; Duker & Morsink, 1984) have found that the procedural contrast, the difference between probe and training conditions, negatively affects student performance under probe conditions. Buchwald summarized the results of five experiments conducted with college students. The students were trained to match nonsense

syllables to numbers on flash cards. Each experiment compared performance during the training conditions (with different contingencies of feedback and reinforcement) to the probe condition that followed training. Probe conditions consisted of a minimum of 48 consecutive trials with no feedback or reinforcement. In all of the experiments, correct responding returned to chance levels during the probe phase. Duker and Morsink (1984) trained 4 adults with autism to select preferred items or activities in response to teacher prompts. However, when reinforcement was withheld, under the probe condition, subjects did not demonstrate the response.

Other studies have found that student performance improved after repeated exposure to probe conditions (Frankel, Simmons, Fichter, & Freeman, 1984; Schriebman, Koegel, & Craig, 1977). The primary question in both of these studies was related to stimulus over-selectivity. Researchers were interested in the specific characteristics of training stimuli to which subjects attended. All characteristics were present during training, and only one during probe condition. Schriebman, et al. (1977) trained 16 children with autism to touch picture cards. Under the training condition, children responded to cards with two pictures, received feedback about responses, and received food reinforcers for a correct response. Under the probe condition they responded to one picture and received no feedback or reinforcement. Probe trials were mixed

with training trials at a ratio of 1 probe per 2 training trials. After mastery of training, performance on the first third of 48 probe trials was compared to performance on the last third. The students' performance improved after repeated exposure to probe conditions.

Frankel, et al. (1984) attained similar results with 7 children having autism or mental retardation. The children were trained to push a lever to receive food in response to a visual and auditory signal. During the probe condition, only one signal was present and no food was available. The researcher also monitored the pulse rate of the respondents as a measure of their anxiety level. There was no statistically significant difference in pulse rate under probe and training conditions and the subjects performance during probe improved over time.

Research results have been inconclusive about the relationship between student performance under training and probe conditions. The assumption that probe procedures have the same effect on student performance as extinction procedures was supported by Buchwald (1959a; 1959b; and 1960) and Duker and Morsink (1984). However, the results of Frankel, et al. (1984) and Schriebman, et al. (1977) were in direct contrast. Subjects' performance under probe conditions in these two studies actually improved with

repeated exposure to probe. Therefore, no conclusions about the impact of probe conditions on student performance can be made at this time. The assumption that probe data reflect student performance under natural conditions also has not been clearly demonstrated. Training and assessment in the studies discussed above were conducted in laboratory settings. Also, skills such as nonsense syllable recognition and pressing levers for food are rarely required in natural settings. There is no evidence from existing research to show that probe data more closely represent performance under natural conditions than does training data.

The following study was conducted to investigate further the effects of contrast between probe and training conditions on student performance. This study utilized data collected in public school and community settings (rather than laboratory settings) and examined student performance on multiple-step, functional skills. Specifically, the relationships between training and two different types of probe procedures were explored. The two probe conditions were: (a) multiple-opportunity (i.e., student is given the opportunity to perform each step in a task analysis), and (b) single-opportunity (i.e., student is not given the opportunity to complete the task after the first error). It was hypothesized that student performance on multiple-opportunity probes would be more highly correlated with training because the student is given the

opportunity to perform every step on the task. The disadvantages of the multiple-opportunity probes are that the student may experience frustration when assistance is repeatedly withheld, and this method requires more time than the single-opportunity probe which could be used more profitably for instruction. The alternative procedure, single-opportunity probe, is more time efficient because the teacher may begin instruction after the student's first error. It has been suggested that the single-opportunity probe is also a more conservative measure because students are not given an opportunity to complete all of the steps they may have mastered (Snell & Browder, 1986; Snell & Grigg, 1987). In this study, the relationship between student performance during training and during probe was examined separately for each of the probe conditions.

The experiment was designed to address five questions:

1. Is performance under training conditions correlated with performance under probe conditions?

2. Are probe data a more conservative measure of student performance than training data?

3. Are probe data collected under the multiple-opportunity condition more highly correlated with training performance data than probe data collected under the single-opportunity

condition?

4. Is student performance more variable under single-opportunity conditions than under multiple-opportunity conditions?

5. Is the difference between probe and training performance greater under the single-opportunity probe condition than under the multiple-opportunity probe condition?

Method

Sample

Over 500 records of students' performance on instructional programs of 54 students were submitted by 13 teachers of students with severe handicaps in the Central Virginia region. Each record contained instructional program information, student performance data collected during training conditions, and student performance data collected during probe conditions.

A sample of 19 data sets were randomly selected for this study. To be selected, a data set met the following conditions: (a) training had been implemented for at least 15 days with some probe trials so that students had been exposed to both probe and training conditions; (b) records included at least 10 probe and 10 training points after the initial 15 days of training; (c) data reflected the acquisition of a multiple-step task which would be functional for the student in natural settings; and (d) no more than one data

set per student was included in the sample. Additionally, data sets were selected so that both multiple-opportunity probe and single-opportunity probe were represented.

The sample consisted of data collected by five teachers, representing two different school systems. All of the teachers had completed advanced training in special education for students with severe handicaps. The graduate program they completed required competency in data collection. The school districts employing the teachers required frequent data collection on all objectives and provided the support to accomplish this. All of the teachers collected data during each instructional session for all objectives. Additionally, the teachers cooperated with a local university in providing a setting for practicum students and a variety of research projects. These factors indicated teachers were skilled in accurate data collection.

The characteristics of students and program data selected for this study are presented in Table 1. All students in the sample were characterized as having severe to profound mental retardation. Ten of the students had additional physical or sensory impairments, including visual and auditory impairments and/or physical disabilities that prevented independent mobility. When teachers reported that contingencies for maladaptive behaviors were present

in almost all of the student's instructional programs that student was described as having maladaptive behaviors. Skills represented all domain areas. The system of least prompts was the most common instructional strategy, though time delay and graduated guidance were also represented.

Insert Table 1 about here

Reliability

Interobserver reliability data were collected on 13 of the 19 programs (68%) selected for this experiment. These data were collected by teachers, aides, practicum students, or research assistants. Reliability data were collected on 8% of the probe trials included in this sample. The percentage of trials per program on which reliability was collected ranged from 2 to 29.

In all cases, interobserver reliability data was collected by the trainer (e.g., teacher, aid, etc.) and an independent observer recording student performance on a task analysis. Percent agreement was calculated by dividing the number of steps on which the two observers agreed by the total number of steps. Agreement on each program for which reliability data was collected ranged from 60-100 percent. The average reliability per program ranged from 87-100%. The average reliability for all the programs

(calculated by multiplying the average reliability for each program by the number of reliability sessions for that program and then dividing the total of these by the total number of reliability sessions) was 98%.

All teachers included in the sample had taken some reliability data on some of their programs. Due to the training and experience of the sample teachers, the supervision and support for data collection they typically received, and the randomized procedures used to select programs, the reliability levels for the trials for which these data were collected are assumed to be representative of the entire sample.

Procedure

The data examined included: (a) the percent of steps a student completed on the task analysis without assistance under both probe and training conditions; (b) the correlations between the percent correct on each probe trial and the percent correct on the training trial conducted closest in time to that probe trial; and (c) the average difference of percent correct between each matched training and probe trial. The number of pairs of data points per data set ranged from 10 to 30. The number of pairs varied among student records depending on the length of time the program had been implemented and the schedule of probe trials. For programs

containing more than 30 pairs of data points, a subset of 30 pairs were selected through a stratified random procedure.

Data analysis procedures will be discussed in reference to the research questions. The first two questions were concerned with the relationship between probe and training in individual programs. To determine if performance under training conditions is related to performance under probe conditions, Pearson product moment correlations were computed between the pairs of percent correct scores under probe and training conditions for each program. (The SPSS Information Analysis System was used to compute statistics.) The second question addressed whether or not probe data are a more conservative measure of student performance than are training data. The difference was computed between performance on each probe trial and the training trial closest in time.

The next three questions were concerned with differences in the relationship between performance under probe and training conditions according to the type of probe procedures implemented. To determine if probe data collected under multiple-opportunity conditions were more highly related to training performance than data collected under single-opportunity probe conditions, t-test for independent groups was computed. The correlations between probe and training data were the dependent measure. Another t-score was computed on the standard deviations of the probe scores

to determine if student performance was more variable under single-opportunity probe conditions than under multiple-opportunity probe conditions. Finally, to ascertain whether the difference between probe and training performance was greater under the single-oportunity probe condition than under the multiple-opportunity condition, t-score was computed on the average difference between performance on each probe trial and the training trial closest in time.

Additional analyses were conducted to examine the differences between single-opportunity condition and multiple-opportunity condition groups. The equivalence between probe condition groups was assessed for: a) the number of pairs of data points included for each program; b) the number of steps in each task analysis; c) the presence of additional physical or sensory handicaps; d) the presence of maladaptive behaviors; e) program domain; f) instructional strategies; and g) teacher. T-tests were conducted to test the differences between probe conditions based on the number of pairs entered per program, the number of steps in each task analysis, and student characteristics. Chi square analyses were used to test for the relationship between conditions and program characteristics.

Results

Individual correlations for each program are presented in Table 2. Performance under training conditions was significantly related to performance under probe conditions at the .05 level in four of ten programs under the multiple-opportunity condition and only one of nine programs under the single-opportunity condition. Correlations ranged from .03 to .83 in the multiple-opportunity condition and from .12 to .47 in the single-opportunity probe condition. This range of correlation suggests that performance under training conditions is sometimes related to performance under probe conditions, and at other times is unrelated.

Insert Table 2 about here

The differences between percent correct on each probe trial and the training trial closest in time are listed in the sixth column of Table 2. In eight of the 19 cases, students performed better under probe conditions than under training conditions. This direction of difference between performance under probe conditions and performance under training conditions was unexpected. These findings contradict the assumption that probe data are more conservative than training data.

Differences between single-opportunity and multiple-opportunity conditions are reported in Table 3. There were no significant differences between the single-opportunity probe condition group and the multiple-opportunity probe condition group on correlations between performance on probe and performance on training. There was a significant difference between the two probe groups on the amount of variance. The standard deviations of probe performance under single-opportunity conditions was significantly greater than the standard deviations under multiple-opportunity conditions. There was no statistically significant difference in the variance of training performance. The t-test indicated that the difference between probe and training performance was significantly greater under the single-opportunity probe condition than the difference between probe and training performance when multiple-opportunity probes were implemented.

Insert Table 3 about here

In addition to tests for the research hypotheses, an analysis of equivalence of probe condition groups was conducted. There was no statistical difference between the single-opportunity and multiple-opportunity probe condition groups according to various program characteristics: (a) the number of steps in the task

analysis; (b) the teacher who submitted the student record; (c) the domain; or (d) the instructional strategy. There also were no statistical differences between the probe condition groups according to number of data points entered for each record or the presence or absence of physical or sensory handicaps in the student. However, students with maladaptive behaviors were represented in a significantly higher number in the multiple-opportunity probe group.

Insert Table 4 about here

Discussion

The results of this study suggest that assessment of student performance under probe conditions is not detrimental to student performance and may provide teachers with valuable information. The first question in this study addressed whether or not student performance under training conditions is correlated to performance under probe conditions. This question is of particular importance to teachers who collect data only under training conditions, but are interested in performance under natural conditions. The results of this study indicate that student performance under training conditions was related to performance under probe conditions in five of the 19 programs. For teachers primarily

concerned with student performance under "natural" conditions, collecting data only under training conditions may not provide them with the information they need to assess student progress.

The second question addressed whether or not probe data are a more conservative measure of student performance than training data. If it is true that students react to probe conditions in the same way they react to extinction conditions, as suggested by Cuvo (1979), then student performance scores under probe conditions would be lower than performance scores collected under training conditions. In this study, when student performance under probe and training conditions was compared, students sometimes performed better under probe conditions than under training conditions, sometimes worse, and sometimes about the same. The assumption that probe data provide a conservative measure of student performance was not supported by these results.

The third question was: are probe data collected under the multiple-opportunity condition more highly correlated with training performance data than performance data collected under the single-opportunity condition? Results indicated that the difference between the correlations of training and probe performance data was not significant according to the type of probe procedure used. These results were unexpected as it was hypothesized that multiple-opportunity probes would be more highly correlated with training

since studetns are given the opportunity to perform all of the steps in the task.

The next question examined the difference between variability under single-opportunity and under multiple-opportunity conditions. Student performance under multiple-opportunity conditions was expected to be more stable because students were allowed to perform the same number of steps in both probe and training trials. Under the single-opportunity condition, students who knew most of the steps in a task could receive significantly lower probe scores if an error occurred early in the task. The results of this study supported this logic: scores obtained under single-opportunity conditions are more likely to be more variable than scores obtained under the multiple-opportunity condition. These results indicate that teachers may need to use different criteria for evaluating progress depending on the probe condition (i.e., When using a single-opportunity probe, a teacher could be less concerned about variability than when using a multiple-opportunity probe.).

Finally, this study addressed the question: is the difference between probe and training performance greater under the single-opportunity probe condition than under the multiple-opportunity condition? If student performance on multiple-opportunity probes is more like performance during training because students have the opportunity to perform all the steps, then probes scores would be

closer to training scores under the multiple-opportunity condition. The results of this study supported this logic; the difference in performance between training and probe conditions was significantly greater under the single-opportunity probe condition than under the multiple-opportunity condition.

The results of this study differed from those of Buchwald (1959a; 1959b; 1960) and Duker and Morsink (1984). The conditions in this study varied from those in Buchwald's series of experiments. The current experiment used data collected on the performance of students with severe handicaps and probe trials were interspersed with training trials, so students did not have to perform for extended trials with no reinforcement. The contradictory results of these two studies are not surprising considering these differences in procedures.

The contradictions between this study and Duker and Morsink (1984) are not as easily explained. Duker and Morsink (1984) varied probe and training trials and conducted the study in a classroom setting. They taught students to request preferred activities with signs. However, teachers did not respond to student requests during the probe condition. This made the use of signing non-functional for students under the probe condition. By contrast, the skills included in the current study did not lose

their functional value under probe conditions (e.g., in a "coat-off" program, the student's coat was removed under both training and probe conditions). The final result for the student was the same under both conditions. This difference may have caused students to respond differently.

Cuvo's (1979) argument against the use of probe procedures may not be applicable to classroom conditions when probe trials are mixed with training trials. Indeed, the teacher may gather essential data from probes. The lack of a relationship between probe and training and the difference in performance on probe and training indicate probe conditions require the student to perform a different task (i.e., generalization) than is required during training. Teachers' major concern when teaching a skill is that students can perform the skill under natural conditions. In order to be sure training is having an effect on performance under natural conditions, performance should be measured under those conditions. Additionally, this study found that student performance, in some cases, was better in probe situations than in training. In these cases, teachers may be wasting time by continuing instruction on tasks the student already can perform.

The conclusions drawn from these experiments should be viewed cautiously due to the use of repeated statistical tests and possible non-equivalence of groups. The groups differed

significantly on the number of students with maladaptive behaviors. However, the groups were selected with random procedures.

In summary, the results of this study indicate that performance under probe and training conditions may or may not be related, and that there is no difference in the relationship in regard to the type of probe procedure used. Single-opportunity probe data do not appear to yield more conservative results than do multiple-opportunity probe data, although single-opportunity scores are more different from training scores than are multiple-opportunity scores, and performance on single-opportunity probes are more likely to be variable. No recommendations can be made about the advantages of either probe procedure based on these results.

Additionally, the results of this study indicate that probe procedures are not detrimental to student performance and may provide valuable information to teachers. This study was limited to a select group of teachers of students with severe handicaps. Further examination of the relationship between performance under probe conditions and performance under training conditions is needed with broader samples of both students and programs. Also needed is further exploration of the types of probe procedures that may provide the most information under various programs or students.

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Table 1

Sample Characteristics

Multiple-Opportunity Condition					
	Student Characteristics		Program Characterstics		
Ss	Physical/ Sensory Handicaps	Maladaptive Behaviors	Skill	Domain	Instructional Strategy
1	No	Yes	Handwashing	Domestic	Least Prompts
2	No	Yes	Play Tape Recorder	Leisure/Recreation	Least Prompts
3	No	Yes	Greeting	Community	Least Prompts
4	Yes	Yes	Greeting	Community	Least Prompts
5	No	No	Use the Bathroom	Domestic	Least Prompts
6	Yes	No	Greeting	Community	Least Prompts
7	No	Yes	Recipe Cards	Domestic	Least Prompts
8	Yes	Yes	Greeting	Community	Least Prompts
9	No	Yes	Showering	Domestic	Least Prompts

(table continues)

10	Yes	No	Coat-off	Domestic	Least Prompts

Single-Opportunity Condition

	Student Characteristics		Program Characterstics		
Ss	Physical/ Sensory Handicaps	Maladaptive Behaviors	Skill	Domain	Instructional Strategy
11	No	Yes	Telephone Assembly	Vocational	Least Prompts
12	No	Yes	Convenience Store Use	Community	Graduated Guidance
13	Yes	No	Hospital Kit Packaging	Vocational	Least Prompts
14	No	No	Spotlight Assembly	Vocational	Least Prompts
15	Yes	No	Use of Fast Food Restaurant	Community	Least Prompts
16	Yes	No	Use of Fast Food Restaurant	Community	Graduated Guidance
17	Yes	No	Handwashing	Domestic	Time Delay

(table continues)

18	Yes	No	Use of Fast Food Restaurant	Community	Least Prompts
19	Yes	No	Use of Fast Food Restaurant	Community	Time Delay

Table 2

Correlations for Individual Programs

Multiple-Opportunity Condition						
	Probe		Training			
Ss	X	SD	X	SD	D	r
1	61	19	65	17	4	.83***
2	65	11	64	11	-1	.36*
3	70	11	69	12	1	-.03
4	89	21	91	10	2	-.13
5	32	15	35	11	3	.43*
6	83	19	81	19	-3	.59***
7	70	25	76	17	6	.32
8	34	13	39	23	5	.13
9	53	7	65	13	12	.34
10	84	13	71	20	-13	.14
Single-Opportunity Condition						
	Probe		Training			
Ss	X	SD	X	SD	D	r
11	39	26	81	13	42	.24
12	84	21	94	9	10	.47

(Table continues)

13	63	38	82	22	19	.30
14	64	35	95	7	31	.14
15	67	37	49	46	-18	.12
16	99	4	93	16	-6	.16
17	26	15	24	19	-2	.47**
18	63	30	54	41	-9	.30
19	82	30	76	30	-6	.15

* $p \leq .05$. ** $p \leq .01$. *** $p \leq .001$.

Table 3

Comparison of Probe Conditions

Variables	Mean	SD	T-Value
Correlation Between Probe & Training			
Multiple-opportunity	.30	.14	-.37
Single-opportunity	.26	.14	
Probe Variance			
Multiple-opportunity	15.49	5.40	2.61*
Single-opportunity	26.25	11.26	
Training Variance			
Multiple-opportunity	15.41	4.36	1.44
Single-opportunity	22.45	14.04	
Difference Between Probe & Training			
Multiple-opportunity	4.81	4.24	2.43*
Single-opportunity	15.86	13.35	

* $p \leq .05$.

Table 4

Results of Tests for Group Equivalence

Characteristic	T
Maladaptive Behavior	2.24*
Physical/Sensory Handicaps	-1.14
Steps in the Task Analysis	1.47
Pairs Entered	.17
	X^2
Teacher	4.29
Domain	6.74
Instructional Strategy	5.63

* $p < .05$.